MSAs 26 to 50; and three (3) complexes may be located in MSAs 51 to 100, one of which must be Honolulu, Hawaii (for a complex at Waimea). Any location allotted for one range of MSAs may be used for an MSA below that range.

(ii) eligibility to operate such feeder link earth stations will be limited to MSS entities which proposed prior to June 3, 1991 (established by Public Notice dated April 1, 1991, Report No. DS-1068) to operate such feeder link stations in the 29.1-29.3 GHz band. To be retain such eligibility, at least 45 days prior to the commencement of LMDS auctions, such entities shall specify a set of geographic coordinates for its feeder link earth station complexes consistent with section (a)(3)(i).

(b) Joint ventures between and among LMDS operators, FSS earth station operators and eligible MSS earth station operators will be permitted to participate in the competitive bidding.

NRMC/91.1

Sep. 23, 1994

NRMC Members Supporting
Auction of 28 GHz
September 20, 1994

[illegible]
Representative

mm-Tech, Inc
Organization
****

Jim Schill
Representative

RioVision Inc.
Organization
****

Mitchell J. Reynolds
Representative

ICVA
Organization
****

Glenn Robinson
Representative

Texas Instruments
Organization

[illegible]
Representative

Suite 12/CVN/RP.
Organization
****

D. Tim Campbell
Representative

Bell Atlantic
Organization
****

Penny W. Hadden
Representative

International Communications Eng. Inc. and
GHz Equip. Co Inc
Organization
****

Richard Compton
Representative

Providing minority owned Company interests addressed

AVCCA Labs.
Organization

NRMC Members Supporting
Auction of 28 GHz
September 20, 1994

Representative
* SUBJECT TO NRMC 19.2

Video/Phone Systems, Inc.
Organization
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Representative

Organization
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Representative

Organization
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Organization

Representative

Organization

ICE GROUP

INTERNATIONAL
COMMUNICATIONS
ENGINEERING
GROUP, INC

International Communications Engineering Group
George W. Soderquist
1433 East Second Ave.
Mesa, AZ 85204 USA
ICE-G.

September 29, 1994

Ms. Susan E. Magnotti
Common Carrier Bureau
Federal Communications Commission
Room 6218
2025 M Street, N.W.
Washington, D.C. 20554

Re: Supplemental Submission of International Communications Engineering, Inc. For Inclusion In The Final Report of The LMDS/FSS Negotiated Rulemaking Committee

CC Docket No. 92-297

Dear Ms. Magnotti:

International Communications Engineering Group, Inc. ("ICE G") hereby submits this letter for inclusion in the Final Report of the LMDS/FSS Negotiated Rulemaking Committee (the "NRMC"). ICE G's representation to the NRMC was consolidated with GHz Equipment Corporation ("GEC"). ICE G was formed with the intent of developing network designs and specific product offerings to address marketplace demand for LMDS systems and components. ICE G is in general concurrence with the views expressed by GEC throughout the NRMC process. ICE G is compelled, however, to clarify its stance as set forth below with regard to certain positions advanced by GEC on ICE G's behalf.

1) ICE G takes exception to GEC's representation on ICE G's behalf that all of the consolidated parties represented by GEC contemplate deploying LMDS systems that are fully compatible with the LMDS system approach delineated by the Suite 12 Group. In fact, ICE G contemplates the deployment of LMDS systems that will more closely resemble more robust LMDS architecture concepts, such as those advanced by Video/Phone Systems, Inc.

2) ICE G also takes exception to GEC's assent on ICE G's behalf to the proposed rules for LMDS/Non-GSO MSS feederlink sharing advanced by Motorola and Suite 12.

United States Office
1924 Girard, NE
Albuquerque, New Mexico
USA 87104
(505) 845-5221

Canadian Office
10234 - 125 Street
Edmonton, Alberta
Canada T5N 1S9
(403) 451-6088

ICE GROUP
INTERNATIONAL COMMUNICATIONS ENGINEERING GROUP, INC

Specifically, ICE G believes that the Motorola/Suite 12 rule proposal is defective in the following respects:

- The aggregate power density limit values set forth at proposed Rule Section 21.1020 of the Motorola/Suite 12 proposed rule will impose an inequitable burden on LMDS operators. ICE G maintains that Non-GSO feederlink operators should be required to increase their transmit EIRP to a level equivalent to 10 dBW higher than the transmit EIRP proposed for the Motorola feederlink earth stations. The power spectral density limits imposed on LMDS operators to protect Non-GSO MSS feederlink operations should be derived from the resulting modified Non-GSO MSS feederlink earth station transmit parameters.

- No valid technical basis has been demonstrated to justify a complete ban on LMDS return link operations in bands shared with Non-GSO MSS feederlinks. The provisions allowing backbone link operations and banning subscriber links set forth in Motorola/Suite 12 proposed rules 21.1018 and 21.1019 should be replaced with a provision that allows for a flexible use of return links that results in a similar distribution of high-gain point-to-point operations in an LMDS network.

- The 75 mile "protection zone" proposed in the Motorola/Suite 12 rules should be modified to also require designation of a second inner circle at least 35 miles inside 75 mile perimeter, and Non-GSO MSS feederlink complex earth stations should be required to be located within this inner circle. Unless this second inner circle is added, LMDS operators will not have any reasonable assurance of protection from unacceptable Non-GSO MSS feederlink interference outside of the 75 mile protection zone. A traditional coordination contour approach, such as the procedure set forth in Section 25.209 of the Commission's Rules, could be employed as an alternative to the proposed fixed 75 mile protection zone approach.

3) ICE G believes it would be needlessly restrictive for the Commission to adopt LMDS rules imposing specific recommended or required LMDS system designs or

United States Office
1924 Girard, NE
Albuquerque, New Mexico
USA 87104
(505) 845-5221

Canadian Office
10234 - 125 Street
Edmonton, Alberta
Canada T5N 1S9
(403) 451-6088

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GROUP
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ENGINEERING
GROUP, INC

operational techniques without a valid technical reason for doing so. Proposed Motorola/Suite 12 rule Sections 21.1023 and 21.1024 are examples of proposed rules of this type that clearly lack any legitimate technical basis. In devising LMDS service rules, the Commission should emphasize technology neutrality and flexibility to accommodate future technological developments.

ICE G believes that the LMDS/FSS NRMC was a success, despite the fact that no consensus was reached on major issues. The NRMC developed a valuable record that advances the progress of the LMDS rulemaking and documents several possible approaches to co-frequency co-primary LMDS/FSS sharing. ICE G believes the Commission should strongly encourage the interested parties to continue seeking agreement on a practical rule structure for co-frequency co-primary LMDS/FSS sharing in the 28 GHz band. If there are any questions concerning this letter, please do not hesitate to contact the undersigned.

Very truly yours,

George W. Soderquist
George W. Soderquist
Vice President

United States Office
1924 Girard, NE
Albuquerque, New Mexico
USA 87104
(505) 845-5221

Canadian Office
10234 - 125 Street
Edmonton, Alberta
Canada T5N 159
(403) 451-6088

NRMC-

SOME BRIEF OBSERVATIONS AT THE CLOSE OF THE 28 GHZ NEGOTIATED RULEMAKING COMMITTEE PROCEEDINGS

Submitted by
Martin Marietta Astro Space

1. Committee Charter

As we conclude these NRMC proceedings, it is important to understand not only what the Committee was chartered to consider, but also what it was not. The committee charter specifically excluded consideration of lateral issues such as:

Public Interest
Potential Economic Advantages and Disadvantages of the Various Proposed Systems
Use of Auctions or Lotteries to Adjudicate Spectrum Between Proposed Systems

We strongly support this approach of seeking a purely technical solution prior to entering into controversial discussions of the relative merits of various proposed systems in the public opinion and legislative arenas.

It should be noted that, in several instances, Committee delegates attempted to introduce discussion of these excluded topics into the Committee proceedings.

2. Technical Issues Not Discussed

The Committee charter was narrowly interpreted to constrain discussion to co-frequency sharing of the same spectrum only:

a) between LMDS and FSS services, and
b) between LMDS and MSS feeder link services.

This narrow charter interpretation excluded discussion of the following technical issues:

c) Sharing between GEO FSS satellite systems and non-GEO FSS satellite systems
d) Sharing between GEO FSS satellite systems and non-GEO MSS feeder links
e) Sharing between non-GEO FSS satellite systems and non-GEO MSS feeder links
f) Spectrum efficiency of the proposed systems
g) Possible segmentation of the band among the various services

It is our belief that, had some of these issues been open to discussion, some spectrum sharing solutions might have been arrived at which might have been accepted by a majority of the

Committee members. In our opinion, consideration of all the above issues, as well as consideration of possible use of frequencies outside the 28 GHz band by some services, is necessary to arrive at a sensible and equitable solution for spectrum sharing among all the services.

ADDENDUM ____
9/28/94

DIFFUSE SCATTERING
ADDITIONAL MATERIAL THAT MAY EFFECT THE ABILITY OF LMDS TERRESTRIAL TRANSMITTERS TO SHARE WITH SATELLITE RECEIVERS

NASA

The Section 4.5.2 of the WG1 Report notes that, since the majority of power radiated from an LMDS hub antenna is incident upon the Earth's surface, the effect of diffuse scattering should not be neglected. An extensive search was undertaken to determine levels that might be expected and no directly applicable data was found in the literature. Scattering coefficients in the range of -5 dB to -40 dB were noted for cases of diffuse scatter in the specular direction and for backscatter. Most measured data was for frequencies below 20 GHz.

Document WG1/46 (Attachment XX) evaluated the margin reductions that would be expected for a particular case and served to indicate that further investigation may be needed for transmitting antennas that claim very low sidelobe levels and do not take account of scattering effects.

Additional information concerning the subject of diffuse scattering has been found in CCIR REP. 850-1, Annex III (excerpt attached) that may prove useful.

REPORT 850-1 *

FREQUENCY SHARING BY PASSIVE SENSORS WITH THE FIXED. MOBILE EXCEPT AERONAUTICAL MOBILE, AND FIXED-SATELLITE SERVICES IN THE BAND 18.6-18.8 GHz

Minimum restrictions to other services in order to ensure satisfactory operations of passive sensors

(Study Programme 12B/2)

ANNEX III

EFFECTS OF TERRAIN SCATTERING ON SHARING WITH FIXED AND FIXED-SATELLITE SYSTEMS

1. Introduction

In the analyses contained in this Report, including Annexes I and II, no consideration has been given to scattered energy from fixed transmitters, and only a very general consideration to scattered energy from FSS satellites. The analysis of this Annex is based on a recent model [Nicholas *et al.*, 1983] for analysing surface scattering. This model is an extension of work by [Beckmann, 1963].

2. Scattering analysis for the case of the fixed service

The type of terrain over which a fixed-service transmitter operates is crucial for determining the power scattered towards a passive sensor. Based on the model presented by [Nicholas *et al.*, 1983] and data presented in [Long, 1975] the average surface normalized scattering coefficient, σ_0, would be around -10 dB for urban and residential areas. For heavily forested regions, σ_0 falls in the range of -18 to -10 dB; however, to provide a reasonable conservative bound, a σ_0 of -10 dB is used in the following analysis.

P_i :	power received due to scattering from an elemental area A_i (W),
A_i :	elemental area of the scattering surface (m^2),
$P_T G_T / 4\pi (r_{1i})^2$:	pfd arriving at the elemental scattering surface (W/m^2),
σ_0 :	scattering coefficient (dB),
$1/4\pi(r_{2i})^2$:	spreading loss to the spacecraft (m^{-2}),
$G_R \lambda^2 / 4\pi$:	effective area of the sensor antenna in the direction of the scattering surface (m^2).

The summation is performed over the complete scattering surface A to determine the signal power entering the sensor side lobes, and over the sensor main-beam footprint on the Earth to determine the signal power entering the sensor main beam.

In order to obtain the scattered signal PFD at the Earth's surface, it is necessary to determine the gain contours of the fixed-service antenna on the surface of the Earth. This was done for a typical fixed-service antenna of 40 dBi gain, pointing horizontally and mounted 20 m above the Earth. The gain contours of 25 dBi, 10 dBi, 0 dBi and -5 dBi * are plotted in Fig. 7. The line-of-sight distance for a 20 m antenna height is 16 km.

2.1 *Side-lobe case*

The line-of-sight region, a circle of 16 km radius, was divided into areas with sizes of 0.5 × 0.5 km, 1 × 1 km and 2 × 2 km in order to accurately perform the summation over the gain contours. The total power summation was then calculated over the complete area A. For a fixed-service transmitter power of 1 W, the area within the $G_T = 25$ dBi contours was found to contribute the equivalent of a 0.15 W transmitter with an omnidirectional antenna located at the centre of A. The balance of the total scattering area contributes 0.10 W for a total of 0.25 W omnidirectionally distributed.

For the direct path from the fixed transmitter to the sensor, the power associated with the fixed transmitter −5 dBi side lobes is equivalent to a 0.32 W omnidirectionally distributed transmitter. Thus, scattering will cause the effective side lobe-to-side lobe interference to increase by 2.6 dB. Consequently, the number of 1 W transmitters which would just meet the criterion contained in this Report would be reduced from 10 000 to 5555.

Another way to envisage the results of this analysis is that a line-of-sight transmitter emits half of its power towards the Earth's surface where some is absorbed and some scattered. This analysis indicates that half of the power incident on the Earth's surface is absorbed and half scattered for surfaces with $\sigma_0 = -10$ dB.

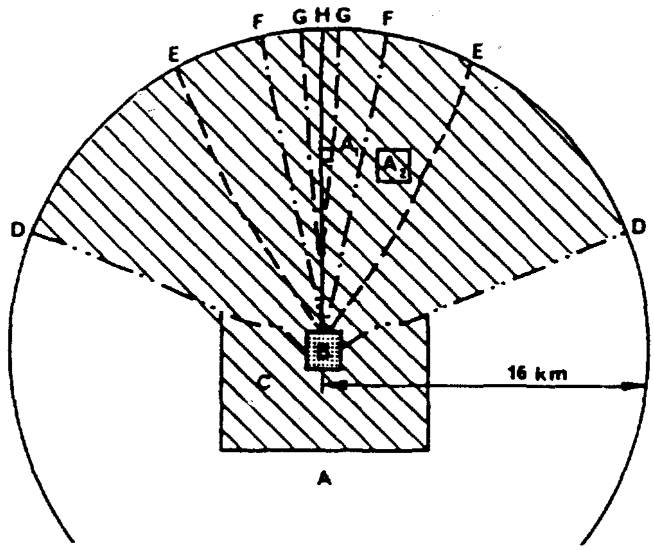

FIGURE 7 – *Fixed antenna ground gain intersections and sensor main-beam data loss area*

A: scattering area

A_1: 0.5 × 0.5 km typical area

A_2: 2 × 2 km typical area

B: 2 × 2 km resolution element lost due to sensor main-beam pointing at fixed station (no scattering)

C: area lost due to scattering when sensor main-beam points into this area (lined area)

D: ——— −5 dBi gain contour intersection with the Earth

E: — — — 0 dBi contour

F: —··— 10 dBi contour

G: —·— 25 dBi contour

H: ——— 40 dBi contour

REFERENCES

BECKMANN, P. [1963] *The Scattering of Electromagnetic Waves from Rough Surfaces*. Pergamon Press, The MacMillan Co., New York, NY, USA.

LONG, M. [1975] *Radar Reflectivity of Land and Sea*. Lexington Books, D. C. Heath and Co., MA, USA.

NICHOLAS, J. *et al.* [May, 1983] Fixed and fixed satellite sharing with passive sensors in the 18.7 GHz region. Final Report. Systematics General Corporation, Sterling, VA, USA.

Comments on Negotiated Rule Making Committee Document NRMC94 with Regard to Test Results Presented by NASA Lewis Research Center and mm-Tech, Inc.

NASA Lewis Research Center
Cleveland, OH

September 28, 1994

Prepared by:

Robert J. Kerczewski
NASA Lewis Research Center
Space Electronics Division

and

James S. Svoboda
NYMA, Inc
NASA Lewis Research Center

INTRODUCTION

Study of test results introduced into the Negotiated Rule Making Committee, and the results of some additional tests preformed at NASA Lewis Research Center indicate that additional comments and clarifications to the original test results are warranted. Three areas are addressed below. The first is the relationship between video picture quality and the measured signal-to-noise ratio (SNR) of a video signal. The second is additional data and comments on the quality of video signals which have been degraded by interference beyond the just perceptible level. The third is the relationship between data rate and the effects of interference.

In addressing the first issue, study of test results provided by mm-Tech Inc (for the Suite-12 group) shows that some clarification of these results beyond the narrative provided by mm-Tech Inc is required in order to correctly understand the results. Tests conducted at NASA Lewis are presented to provide additional understanding of the relationship between the measured SNR of a video signal and it's actual subjective quality. These tests, as well as the test data provided by mm-Tech Inc indicate that the SNR of the video signal (as measured using the Tektronix VM 700A by both NASA and mm-Tech Inc) is extremely inaccurate in predicting the subjective video signal quality, and therefore cannot be used as a quantitative indication of allowable interference levels.

In addressing the second issue, a more complete set of results for assessing the effects of interference on subjective video quality is presented, based on measurements made at NASA Lewis. These results, which were demonstrated during the Working Group 1 meetings using a video monitor, have been put into a written format. They provide additional information into the behavior of the video picture quality under interference conditions; in particular they indicate the severity of degradation under carrier-to-interference ratios (C/I) above those which produce just perceptible interference. These results show that the picture quality can decrease quickly as the C/I decreases beyond the just perceptible level; therefore there is little margin between the just perceptible interference levels and interference levels which would cause intolerable signal degradation.

The third issue is addressed by clarifying the method of C/I measurement in terms of the bandwidth of the interfering signal, and the variation of transmitted power in a working system which results from the bandwidth required to transmit signals of differing data rates. The result is that an apparent increase in acceptable C/I for higher data rates signals is counteracted by the need to transmit higher power levels for higher data rate signals.

Relationship between SNR and Video Picture Quality

1. Measurements at NASA Lewis

In order to assess the relationship between the SNR of a video signal (as measured using the Tektronix VM700A video signal analyzer) and the quality of the resulting picture (as assessed qualitatively), several additional measurements were performed at NASA Lewis. The measurements consisted of recording the VM700A measurement of SNR under interference conditions which resulted in just perceptible degradation.

The C/I ratios required to produce a just perceptible degradation in the video picture quality were previously determined for various conditions and interference types and reported in the original test results presented to the Negotiated Rule Making Committee. In the second set of measurements, presented here,the SNR measurements (from the VM 700A) corresponding to these previously determined C/I's were recorded. The results for four important test cases are shown in Figures 1-4.

Figure 1 shows the results for a 27.5 Mbps SMSK (serial minimum shift keying modulation) interferer, as a function of the frequency offset between the center of the FM spectrum and the center of the interferer spectrum, with the received carrier-to-noise ratio (C/N), not including the interferer, set at 31 dB. The figure shows that the required C/I to produce a just perceptible degradation varies from -2 dB to +20 dB. At the same time, the measured SNR varies from approximately 41 to + 48 dB.

The same parameters, with the exception of the C/N, which is set to 15 dB, give the results shown in Fig. 2. The required C/I for just perceptible degradation varies from -15 to +26 dB, while the measured SNR varies from approximately 34 to 36 dB.

In figure 3, the results shown are for a 27.5 Mbps SMSK signal bursted at a 22.5% duty cycle. The C/I (measured as the peak C/I rather than time-averaged C/I) varies from -2 to +14 dB in order to produce a perceptible degradation. The corresponding measured SNR varies from approximately 38 to 50 dB.

The fourth measurement is for a single narrowband T1 continuous QPSK signal (1.544 Mbps). The results, shown in Fig. 4, indicate a variation of the C/I required to produce just perceptible degradation of 0 to +25 dB. The corresponding measured SNR varies over the range 33 to 51 dB.

Each of these four cases demonstrates that the measured SNR is a poor indicator of the quality of the video picture. The reason for this is the method by which the SNR is measured. In general, the measurement of video SNR is a difficult process, due to the fact that interferers affect different portions of the FM spectrum in different ways. In particular, a narrowband interferer may contribute very little to change the SNR of a video signal,but still affect a portion of the FM spectrum which produces a noticeable effect on the video picture.

The important conclusion is that the measured SNR should not be used to determine acceptable levels of C/I. Such levels must be determined using subjective evaluations.

<u>2. mm-Tech Test Results and Conclusions - Acceptable Values of C/I Based on Measured SNR</u>

The mm-Tech Inc results include a significant array of data indicating measured SNR and subjective video picture quality,based on the TASO SNR/quality scale. In evaluating these results, the observation presented by mm-Tech Inc (number (3) in the Test Results Section) should be further clarified. A table is presented which indicates C/I values resulting in measured weighted SNR's of 42 ± 1 dB, representing Cellular Vision's minimum SNR requirement. The implication is that the C/I levels given in the table can be tolerated by the system.

In fact, as has been shown above, these SNR's do not guarantee an acceptable quality video picture. Further, in examining mm-TechInc's data, as presented in their report, one finds that the C/I's given as corresponding to weighted SNR's of 42 dB actually results in a picture quality rating of "Inferior" (the poorest rating) for two frequency offsets at 64 kbps interference for C/N of 31 dB and 15 dB, and at one frequency offset for the T1 rate interference at a C/N of 15 dB.

For those three cases, as well as for T1 rate interference at C/N of 31 dB and for 27.5 Mbps QPSK at a C/N of 15 dB, there are several frequency offsets which are rated as "Marginal" (the second poorest rating). The inferior and marginal ratings are not acceptable for video transmission.

These results support the conclusion that the measured SNR cannot be used to determine acceptable levels of C/I, and that the C/I's indicated in the mm-Tech Inc report cannot actually support an acceptable video picture quality.

<u>3. mm-Tech Test Results and Conclusions - Plots of C/I and Measured SNR</u>

In Figure 2 of the mm-Tech Inc. report, the C/I as a function of frequency offset is plotted for the 64 kbps, T1 rate (1.544 Mbps), and 27.5 Mbps QPSK interference cases. In each plot, three curves indicate the required C/I ratio to achieve a given measured SNR; the curves correspond to SNR's of 35 dB, 40 dB, and 45 dB. While these curves represent the actual relationship between the C/I and the measured SNR of the video signal, ***it must be emphasized that these curves in no way indicate the quality of the video picture that corresponds to given C/I ratios.*** This fact has been well established above, by both the NASA data and the mm-Tech Inc. data.

Additional Comments and Subjective Observations on the Quality of Video Pictures Degraded by Interference

Additional observation have been made on the quality of video pictures that have been degraded by interference. In the original test report submitted to the Negotiated Rule Making Committee by NASA Lewis, the emphsis was on the C/I which resulted in just perceptible degradation. These additional results indicate the levels of degradation resulting from lower C/I's. These results give additional insight into the margin for tolerance of interference which exists at the just perceptible threshold.

Following is a verbal description of laboratory recorded interference tests. JP denotes the Just Perceptible level of interference in SMPTE color bars. All observations were made at an interfering frequency offset of 0 Hz, and the interference power levels were based on Ka band pre-LMDS receiver power readings. Recordings of the following interference experiments exist for future reference.

<u>5.6% (T1 rate) Bursted 27.5 Mbps SMSK, C/N = 31 dB</u>

JP + 3 dB	Sparks begin to form in color bars
JP + 6 dB	Horizontal lines begin to form from sparks
JP + 9 dB	Horizontal lines are obvious and very strong
JP + 12 dB	Same as +9 dB, but more intense Horizontal lines, no loss of sync.

<u>22.2% (4T1 rate) Bursted 27.5 Mbps SMSK, C/N = 31 dB</u>

JP + 3 dB	Still good picture, no sparks yet
JP + 6 dB	Sparks are obvious, no horizontal lines yet
JP + 9 dB	Horizontal lines appear
JP + 12 dB	Color bars begin to jump, loss of sync.

5.6% (T1 rate) Bursted 27.5 Mbps SMSK, C/N = 15 dB

JP + 3 dB	Sparks slightly more intense than JP case
JP + 6 dB	More sparks than +3 dB case, no horizontal lines yet
JP + 9 dB	Begin to detect horizontal lines
JP + 12 dB	Horizontal lines are obvious
JP + 15 dB	Similar to +12 dB, but lines are slightly more intense
JP + 18 dB	Similar to +15 dB, but lines keep getting more intense
JP + 21 dB	Thick horizontal lines, but no loss of sync.

22.2% (4T1 rate) Bursted 27.5 Mbps SMSK, C/N = 15 dB

JP + 3 dB	Slightly more sparks than JP case
JP + 6 dB	More sparks, but no horizontal lines yet
JP + 9 dB	Still more sparks, but no horizontal lines yet
JP + 12 dB	Very heavy sparks, but still no horizontal lines
JP + 15 dB	Start to detect fat horizontal lines, picture very bad
JP + 18 dB	Loss of sync.

T1 QPSK, C/N = 31 dB

JP + 3 dB	Slightly more distortion (waves) than in JP, mostly in red/magenta
JP + 6 dB	Additional waves in red/magenta
JP + 9 dB	More waves in red/magenta. Waves begin to appear in blue and green
JP + 12 dB	Waves become stronger in blue and green
JP + 15 dB	Severe waves in red/magenta. Slight sparks begin to appear.
JP + 18 dB	Heavy sparks and distortion in nearly all color bars.
JP + 21 dB	Severe distortion in all color bars.

T1 QPSK, C/N = 15 dB

JP + 3 dB	Sparks present in red/magenta.
JP + 6 dB	Medium amount of sparks throughout most color bars.
JP + 9 dB	Heavy sparks.
JP + 12 dB	Slightly worse than JP + 9 dB case.
JP + 15 dB	Very heavy sparks.
JP + 18 dB	Picture begins to jump and lose sync.
JP + 21 dB	Total loss of sync.

27.5 Mbps SMSK Continuous, C/N = 31 dB

JP + 3 dB	Very similar to JP case.
JP + 6 dB	Slight increase in wave distortion intensity.
JP + 9 dB	Further increase in wave intensity.
JP + 12 dB	Sparks appear, heavy waves in all color bars.
JP + 15 dB	Heavy sparks.
JP + 18 dB	Loss of sync.

27.5 Mbps SMSK Continuous, C/N = 15 dB	
JP + 3 dB	Slightly more sparks than JP.
JP + 6 dB	Slightly more sparks than JP + 3 dB case.
JP + 9 dB	Slightly more sparks than JP + 6 dB case.
JP + 12 dB	Heavy sparks in all color bars.
JP + 15 dB	Very heavy sparks, picture quality very poor.
JP + 18 dB	Picture begins to jump and lose sync.
JP + 21 dB	Total picture loss.

The Relationship Between Data Rate and Interference Effects

The conclusion reached in the mm-Tech Inc report regarding the effects of data rate of the interferer upon the effect of the interference requires clarification. The report concludes that "the system is more tolerant of interference at the higher data rates". This conclusion is supported in part by the mm-Tech Inc data, in that the data tables indicate less susceptibility to interference at the lower frequency offsets for the 27.5 Mbps data rate interference than for the T1 and 64 kbps rates. There is no significant difference in results between the T1 and the 64 kbps results, however.

In addition, the difference between the 27.5 Mbps data and the lower rates can be explained by the fact that a significant portion of the interference power for the higher data rate signal falls outside the bandwidth of the FM video signal; although all of the power is measured in the computation of the C/I ratio (as shown in the mm-Tech test setup figure; there is no additional filtering) only a portion of that power is present in the FM video signal bandwidth. This is the same case as for the NASA test setup; all C/I ratios have been based upon the ratio of carrier power to total interferer power.

Another mitigating factor in comparing the data rates that must be considered is the requirement that higher data rate signals occupying a larger bandwidth must necessarily transmit at a higher power level in order to overcome a greater combined noise level due to the larger bandwidth. Thus, a data rate 10 times higher must transmit 10 dB more power to operate at the same bit-error rate performance. When considering this effect, one could just as easily conclude that the higher data rates will pose a greater interference problem than the lower data rates, when viewed in an actual system environment.

The main point to be considered is that it is not possible to conclude that the system can operate at lower C/I levels by transmitting at a higher data rate; the data developed by both NASA and mm-Tech Inc. do not necessarily support this conclusion.

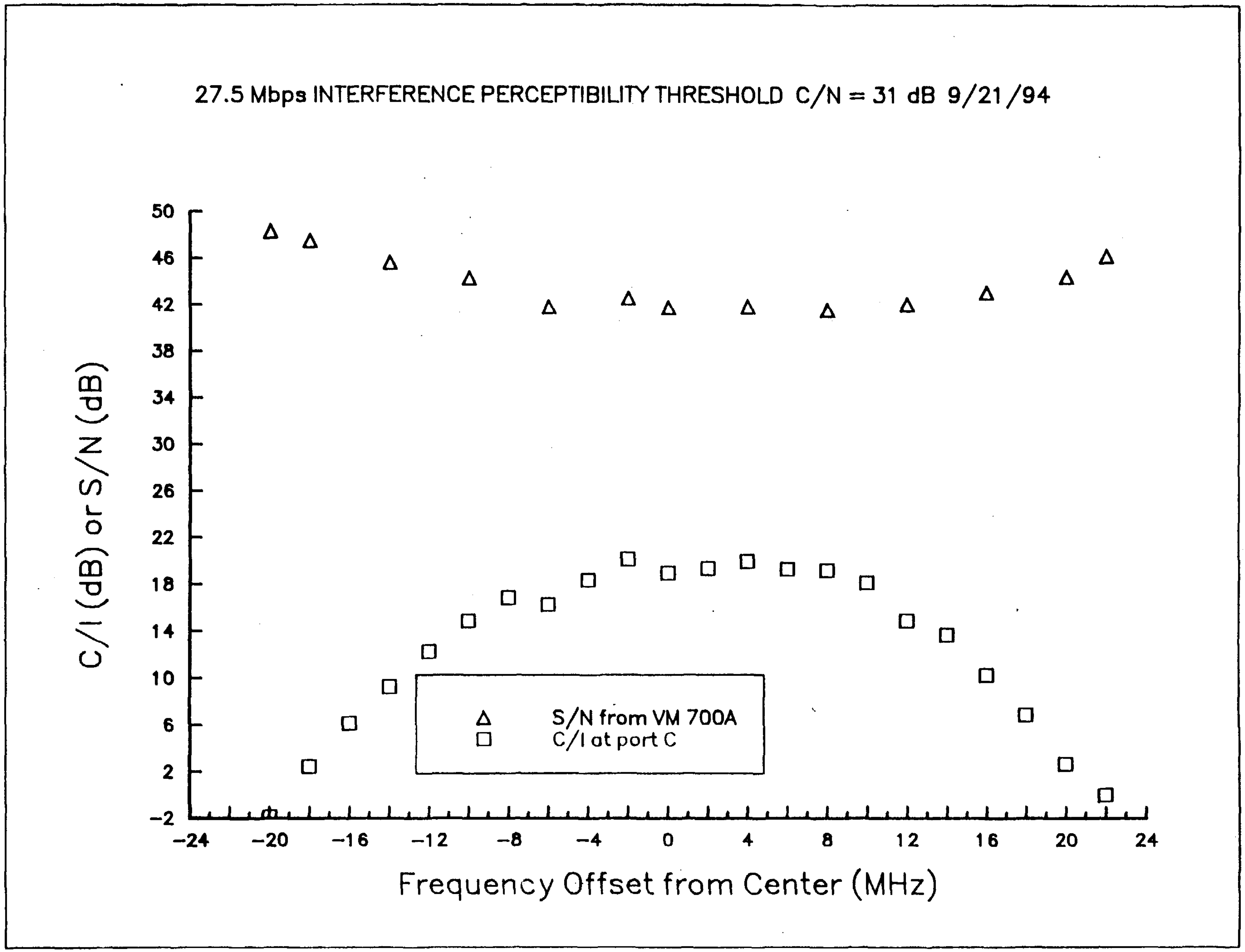

Figure 1 - Measured S/N ratio for C/I ratios which produce just perceptible interference for 27.5 Mbps SMSK interference at a receiver C/N ratio of 31 dB.

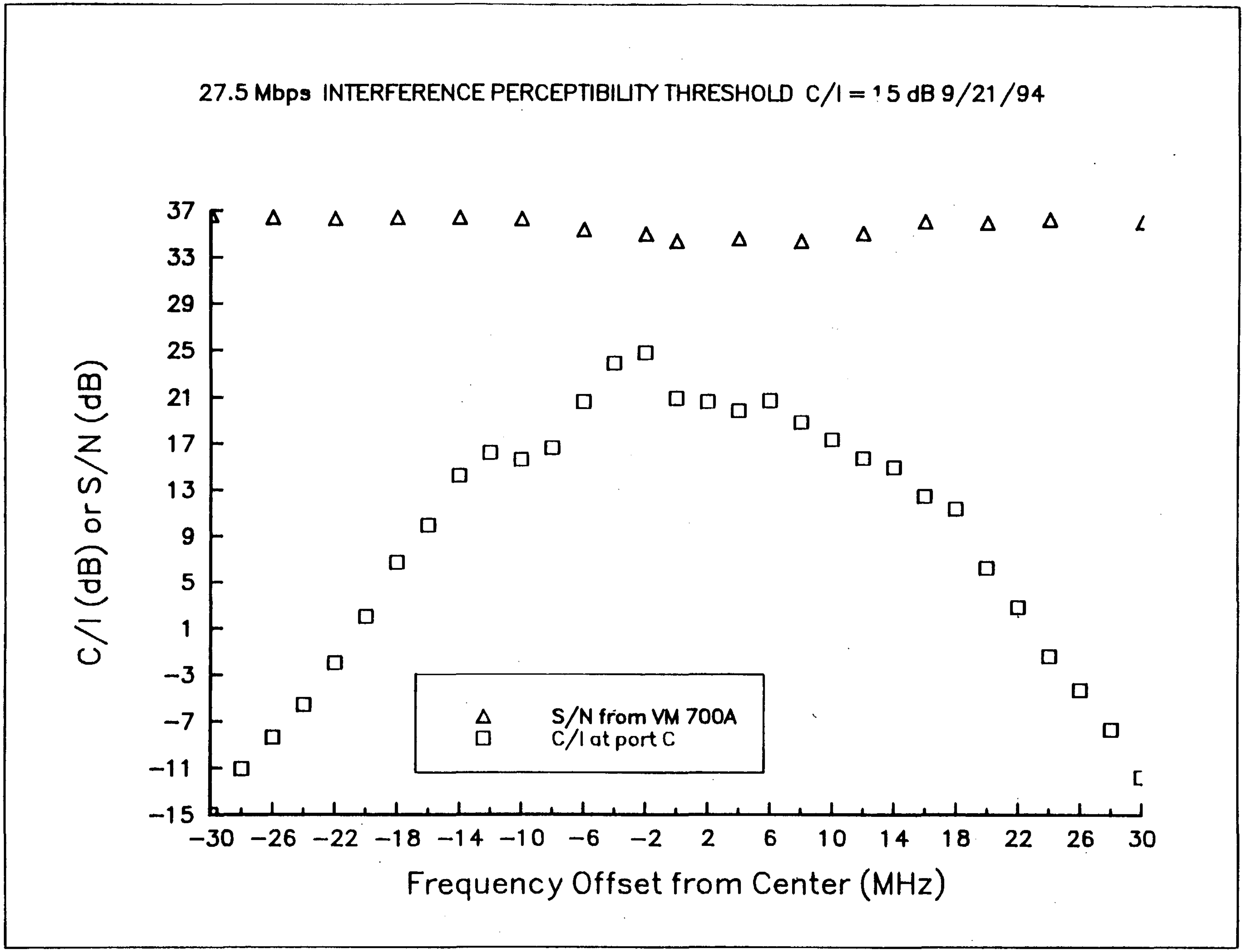

Figure 2 - Measured S/N ratio for C/I ratios which produce just perceptible interference for 27.5 Mbps SMSK interference at a receiver C/N ratio of 15 dB.

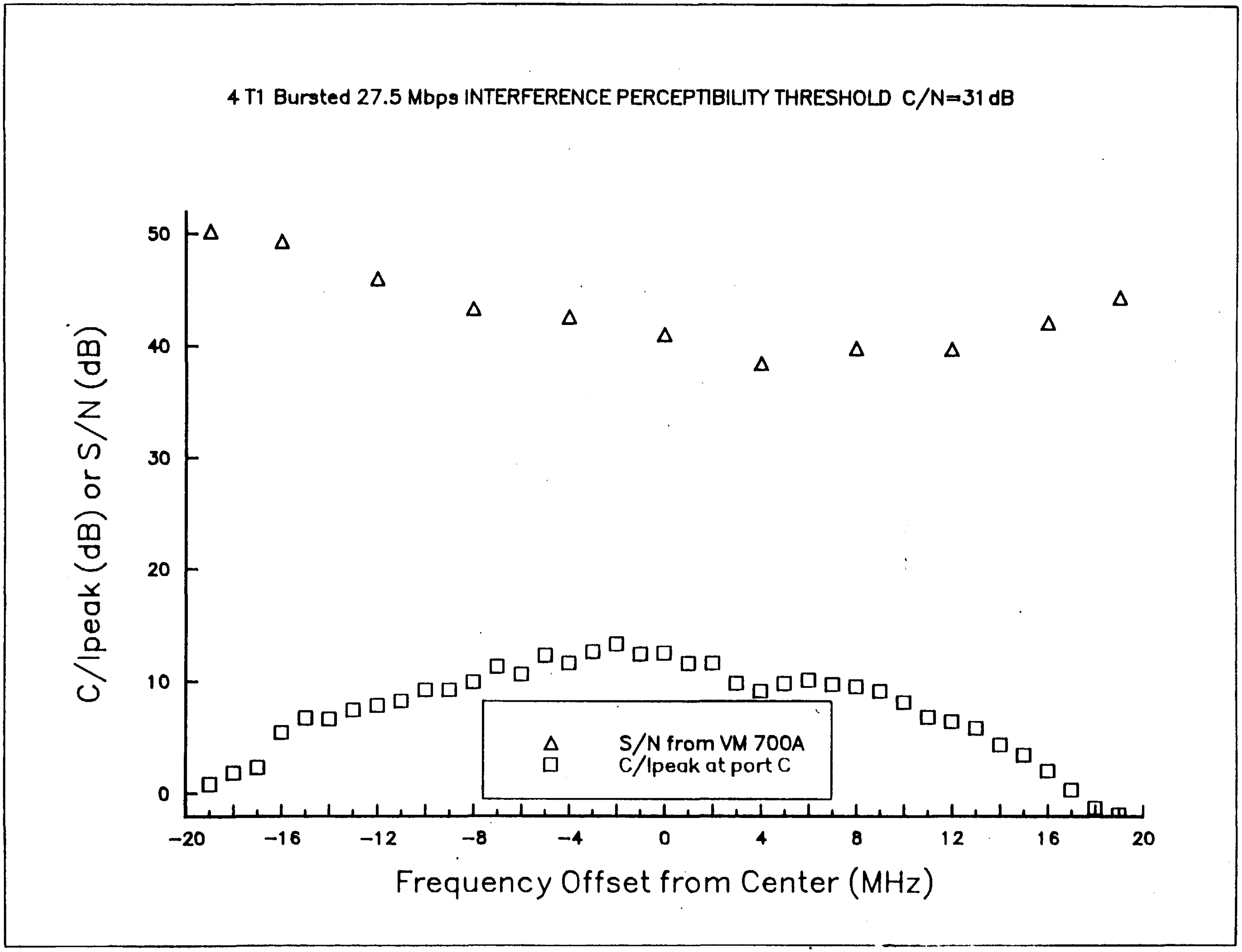

Figure 3 - Measured S/N ratio for C/I ratios which produce just perceptible interference for 27.5 Mbps SMSK interference bursted at 22.5 % duty cycle, at a receiver C/N ratio of 31 dB.

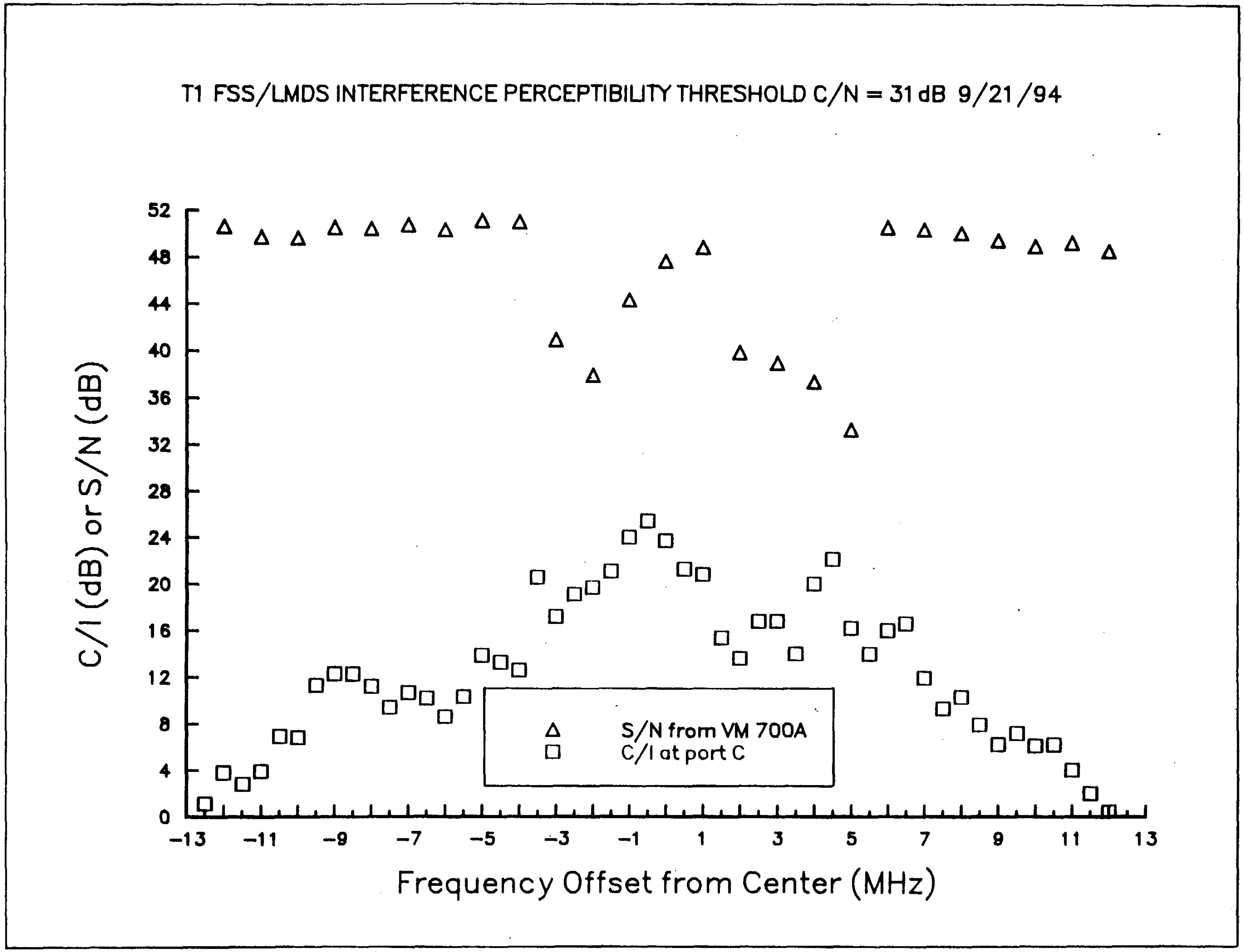

Figure 4 - Measured S/N ratio for C/I ratios which produce just perceptible interference for 1.544 Mbps (T1) QPSK interference at a receiver C/N ratio of 31 dB.

NRMC/84 (Rev. 1)
Sept. 23, 1994

VIEWS OF NRMC MEMBERS SUPPORTING MOTOROLA-SUITE 12/CVNY RULE PROPOSAL IN THE FORM OF THEIR VERSION OF SECTION VI TO REPORT OF WORKING GROUP 2

The following represents the views of those NRMC members who wish to go on record at this time in support of the Motorola-Suite 12/CVNY rule proposal (the "Joint Parties"). These views are provided in the form of their version of Section VI to the Report of Working Group 2. The Joint Parties are identified on the attached signature page .

CONCLUSIONS AND REGULATORY PROPOSALS

6.1 CONCLUSIONS

A. Overview of Conclusions on Sharing Cases Analyzed

(1) LMDS into Non-GSO MSS Feeder Link Satellite Receivers

For transmissions from LMDS hub stations the major mitigation technique is to limit the transmited power at or above the horizon. Using the quick look analysis program, the maximum spectral power density per unit area of hubs was developed for the three climate zones such that the uplink interference would not exceed -13 dB Io/No with the "Quick Look Spread Sheet" (-11.5 dB with Fortran simulation). The hub side lobe patterns are a composite developed from the three LMDS proponents table of characteristics. The spreadsheets developing the limits in Tables 6-1 and 6-2 are detailed in Attachment 1 hereto. The EIRP spectral area density is calculated as follows:

$$10\log\left(\frac{1}{A}\sum_{i=1}^{N}P_iG_i\right)dBW / MHz - km^2$$

where:

N = number of co-frequency hubs in service area

A = service area in km^2

P_i = spectral power density into antenna of i th hub (dBW/MHz)
Gi = gain of i th hub antenna at zero degree elevation angle (dBi)

TABLE 6-1
SPECTRAL AREA DENSITY LIMITS VS. CLIMATE ZONE

Climate Zone	EIRP Spectral Density (Clear Air) ($dBWi/MHz\text{-}km^2$)*
1	-23
2	-25
3,4,5	-26

* See Section 21.1007(c)(i) for the population density of the BTA

TABLE 6-2
SPECTRAL AREA DENSITY VS. ELEVATION ANGLE

Elevation Angle (a)	Relative EIRP Density ($dBW/MHz\text{-}km^2$)
$0° \leq a \leq 4.0°$	$EIRP(a) = EIRP(0°) + 20 \log((\sin\pi x)(1/\pi x))$ where $x = (a + 1)/7.5°$
$4.0° \leq a \leq 7.7°$	$EIRP(a) = EIRP(0°) - 3.85a + 7.7$
$a > 7.7°$	$EIRP(a) = EIRP(0°) - 22$

To protect the satellite against an occasional high level burst of the type that could occur with a backbone station, LMDS backbone transmitting stations should be limited to an EIRP no greater than 23 dBW/MHz. With this limit, the Iridium System carrys an additional 3 dB link margin in order to absorb the occasional main beam to main beam hit that might unlock the satellite demodulator such as might occur with a backbone transmission.

The LMDS operators should also design their go/return channel plan to avoid subscriber transmitter operations in the band designated for non-GSO MSS feeder link bands. Non-GSO MSS operators should restrict operation of their feederlinks to the 29.1 to 29.5 GHz band.

(2) Non-GSO MSS Feeder Link Earth Stations into LMDS Receivers

Clearly, it takes significant LMDS antenna discrimination combined with geographic separation to avoid interference into LMDS receivers from the side lobes of an earth station tracking a Non-GSO satellite to elevation angles as low as 5°. Motorola and Suite 12, therefore, recommended the establishment of zones surrounding fixed coordinates within selected cities where the LMDS operator would not be able to ask for protection from transmissions within the feeder link portion of the band. It was recommended that this region be within a 75 nautical mile radius of the preselected coordinates. Motorola expects to be able to install up to three diversity earth stations within that region. It is further contemplated that coordination between LMDS and MSS operators outside that 75 nm radius would be required. Successful coordination is more likely to be achieved for earth station sites which are some distance within the 75 nm unless terrain shielding and/or site shielding prove to be applicable.

B. Annotation of Proposed Rules

Rule 1:

This rule addresses the issue of potential interference from MSS gateway and satellite control stations into LMDS receivers (NRMC/8, Case 2) by establishing certain requirements for the locations and operations of MSS gateway and satellite control stations, and for LMDS operations in the 29.1-29.5 GHz band.

As an initial matter, it should be noted that the 29.1-29.5 GHz band is the only band segment that would be subject to these requirements because Motorola Satellite Communications, Inc. is the only non-geostationary MSS system applicant which has proposed to operate feeder links in the 27.5-29.5 GHz band, and the particular portion of the band it has proposed to use is 29.1-29.3 GHz. The rules also cover the 29.3-29.5 GHz portion of the band in order to provide for potential feeder link operations by other non-GSO MSS systems in the same processing group as the IRIDIUM System should those other systems, which have proposed to use other spectrum for feeder link operations, be required to utilize Ka-band spectrum for their feeder link operations. It is recognized that in CC Docket No. 92-166, the Commission identified the 29.5-30.0 GHz band, in addition to the 27.5-29.5 GHz band, as a band that could potentially be used to help satisfy the feeder link requirements of those non-GSO MSS applicants who have requested feeder link spectrum below 15 GHz. It is recognized, however, that the 29.3-30.0 GHz band may not provide sufficient spectrum to accommodate all three of the non-GSO MSS applicants who fall into this category, particularly since TRW has requested a portion of the 29.5-30.0 GHz band for its feeder links. To the extent that the 29.3-29.5 GHz band is not used by the other four non-GSO MSS operators, it would be available as potential expansion spectrum for IRIDIUM System gateway operations or for feeder link operations associated with future MSS systems.

Rule 1 contains two fundamental provisions: (1) the establishment of zones around certain protected non-GSO MSS feeder link earth station complexes within which LMDS receive stations must accept any interference caused to them by such earth stations and can claim no protection from such earth stations; and (2) restrictions on the number and geographic location of non-GSO MSS feeder link earth stations in order to minimize the impact of these protection zones on the deployment and operations of LMDS systems. This rule reflects the fact, unlike the case of potential LMDS interference into non-GSO MSS satellite receivers (NRMC/8, Case 6), potential interference from non-GSO MSS systems into LMDS receivers (Case 2) is largely a function of the location of the earth stations. The rule also reflects the likelihood that LMDS systems will be deployed in the band prior to the time that non-GSO MSS systems are deployed. This gives rise to the need on the part of non-GSO MSS operators for assurances that LMDS systems will not be able to claim protection from interfering earth stations on the basis of first-in-time interference rights.

The rule attempts to strike a balance between the needs of non-GSO MSS operators for assurances that their systems cannot be required to cease or restrict operations in response to interference complaints, and the need of LMDS providers for assurances that any encumbrances on their use of the spectrum resulting from the operations of feeder link earth stations will be minimized. For potential LMDS operators, it is important that any possible encumbrances on the spectrum be known prior to the issuance of LMDS licenses, presumably by auction. In this connection, the rule would place limits on: (1) the number of non-GSO MSS operators that could use this band for feeder links; (2) the number of feeder link earth station sites that any one non-GSO MSS operator could establish; (3) the amount of spectrum that any one non-GSO MSS earth station licensee could use at a given location; (4) the number of markets within given ranges of MSAs which could be selected as